Manager, Lake Andes NWR, Lake Andes, S. D.

March 21, 1969

File: RF

Assoc. Regl. Supvr., Mpls., Minn.

Annual Water Program--Lake Andes NWR, 1969

The subject program for the Lake Andes Refuge has been reviewed and approved by this office.

The Division of Engineering has provided some corrected tables for computing area capacity and total water use. Please utilize these in your future calculations. These are attached for your use in future reports.

The Division of Engineering has also provided corrected computations for the flow from the artesian well.

Carlsen 3/24

Lynn A. Greenwalt

Attachments
JCCarlsen:mc 3-21-69

03-21-69

ENGINEERING

Regional Supervisor, Division of Wildlife Refuges March 7, 1969

Regional Engineer

EH-R-Lake Andes
Annual Water Program

Lake Andes NWR - Annual Water Program 1969

We have reviewed the subject program and generally concur in the proposed operation.

Brashear 3/7/69

We note that the last gauging record received from this station is for November 1967. It is important that the gauge readings for all impoundments be regularly recorded and transmitted to this office. Therefore, we suggest that the Refuge Manager submit the delinquent reports at his earliest convenience and that future reports be submitted monthly.

Stapleton 3-7-69

Our review of the impoundment data tables and inflow-outflow summary revealed some discrepancies in the area-capacity and total water use computations. Apparently the Refuge Manager is having difficulty using the area-capacity table. We have corrected the 1968 Impoundment Data tables, copies of which are attached. Also attached are revised area-capacity tables for all impoundments. Use of these revised tables may make it easier for the manager to accurately compute areas and capacities in future annual reports, with areas and capacities listed for "even-foot" intervals in elevation.

JDU 3/7

We have also corrected the computation for well water flow diverted into the small wetland development located northwest of Owens Bay. 750 gpm for 84 days is equivalent to only 280 acre-feet and 25 percent of this figure is 70 acre-feet.

John D. Umberger

Attachments
cc: Refuges--RO
SCBrashears:ce

LAKE ANDES NWR
IMPOUNDMENT DATA-1968
OWENS BAY

Month	Elevation ft.	Area ac.	Capacity ac-ft
January	1440.00	194	313
February	1440.00	194	313
March	1440.00	194	313
April	1440.00	194	313
May	1439.64	166	249
June	1439.58	162	239
July	1439.37	145	201
August	1439.20	132	171
September	1439.39	147	205
October	1439.60	163	242
November	1439.66	168	253
December	1439.66	168	253

LAKE ANDES NWR
IMPOUNDMENT DATA-1968
CENTER UNIT

Month	Average Elevation	Area ac.	Capacity ac-ft
January	1430.52	1677	4135
February	1430.52	1677	4135
March	1430.52	1677	4135
April	1430.10	1631	3339
May	1430.01	1621	3169
June	1429.87	1583	2960
July	1428.21	994	776
August	1428.0	902	550
September	1428.87	1282	1525
October	1428.86	1282	1525
November	1428.86	1282	1525
December	1428.86	1282	1525

LAKE ANDES NWR
IMPOUNDMENT DATA-1968
SOUTH UNIT

Month	Elevation ft.	Area ac.	Capacity ac-ft
January	1431.61	1582	6756
February	1431.61	1582	6756
March	1431.61	1582	6756
April	1431.29	1570	6251
May	1431.29	1570	6251
June	1431.16	1565	6046
July	1430.56	1537	5120
August	1429.89	1500	4099
September	1429.61	1477	3688
October	1429.56	1473	3615
November	1429.56	1473	3615
December	1429.56	1473	3615

LAKE ANDES NWR
IMPOUNDMENT DATA-1968
NORTH UNIT

Month	Elevation ft.	Area ac.	Capacity ac-ft
January	1434.27	464	1069
February	1434.27	464	1069
March	1434.27	464	1069
April	1433.16	373	610
May	1433.05	363	565
June	1433.01	360	549
July	1433.00	359	545
August	1433.00	359	545
September	1432.11	242	284
October	1432.02	230	258
November	1432.02	230	258
December	1432.02	230	258

SUMMARY OF INFLOW AND OUTFLOW 1968

	A Ave. Annual Evap.	B 1968 Lake Rise	C Net Gain A+B	D Surface Acres	E Ac-Ft Gain CxD	F Outflow in Ac-Ft	G Total Inflow Ac-Ft E+F
North Unit	3.15	-2.25	.90	327	294	none	294
Center Unit	3.15	-1.66	1.49	1,328	1,979	none	1,979
South Unit	3.15	-2.05	1.10	1,527	1,680	none	1,680
Owens Bay	3.15	- .34	2.81	158	444	80.0	524
Totals				3,340	4,397 +	80.0	= 4,477

Wetland Unit NW of well: 25% of the well flow flowed into this area for 84 days with the well flow at 750 gallons per minute this would amount to 280 acre-feet

1968 Inflow to Refuge = 4477 acre-feet
1968 Outflow from the Refuge (South Unit) = "0" acre-feet

LAKE ANDES NWR
AREA-CAPACITY TABLE
OWENS BAY

Elevation ft.	Area ac.	Capacity ac-ft	Difference Area ac.	Difference Capacity ac-ft
1436.52	0	0	-	-
1437.0	33	16		
			27	45
1438.0	60	61		
			57	75
1439.0	117	136		
			77	177
1440.0	194	313		
			32	211
1441.0	226	524		
			25	244
1442.0	251	768		
			14	186
1443.0	265	954		
			15	201
1443.52	280	1155		

LAKE ANDES NWR
AREA-CAPACITY TABLE
SOUTH UNIT

Elevation ft.	Area ac.	Capacity ac-ft	Difference Area ac.	Difference Capacity ac-ft
1426.25	0	0	-	-
1427.0	812	406	812	406
1428.0	1268	1446	456	1040
1429.0	1427	2793	159	1347
1430.0	1509	4261	82	1468
1431.0	1559	5794	50	1533
1432.0	1596	7371	37	1577
1433.0	1630	8984	34	1613
1434.0	1655	10626	25	1642
1435.0	1665	12293	10	1667
1436.0	1708	13989	43	1696
1437.0	1756	15723	48	1734
1438.0	1801	17909	45	2186
1439.0	1841	19321	40	1412
1439.25	1851	19779	10	458

LAKE ANDES NWR
AREA-CAPACITY TABLE
CENTER UNIT

Elevation ft.	Area ac.	Capacity ac-ft	Difference Area ac.	Difference Capacity ac-ft
1427	195	0		
			707	550
1428	902	550		
			436	1120
1429	1338	1670		
			282	1480
1430	1620	3150		
			110	1894
1431	1730	5044		
			110	1894
1432	1840	6938		
			110	1894
1433	1950	8832		
			110	1894
1434	2060	10726		
			110	1894
1435	2170	12620		
			420	11900
1440	2590	24520		

LAKE ANDES NWR
AREA-CAPACITY TABLE
NORTH UNIT

Elevation ft.	Area ac.	Capacity ac-ft	Difference Area ac.	Difference Capacity ac-ft
1429.25	0	0	-	-
1430.0	32	16	32	16
1431.0	106	85	74	69
1432.0	227	252	121	167
1433.0	359	545	132	293
1434.0	448	948	89	403
1435.0	506	1425	58	477
1436.0	558	1957	52	532
1437.0	601	2545	43	588
1438.0	638	3155	37	610
1439.0	671	3809	33	654
1439.25	680	3975	9	166

ANNUAL WATER MANAGEMENT PLAN, 1969

A. General Water Uses

Lake Andes proper is divided into three management units by two dikes. with control structures. The general flow of water is from the north unit to the south unit. The outlet for the lake is on the south side and flows to the Missouri River. A structure here enables the lake to be held at a maximum of 1437.25.

Owens Bay is seperated from the south unit of Lake Andes by a dike. A control structure in the dike permits us to control the water levels in Owens Bay. An artesian well flows into Owens Bay and any excess water is discharged into the south unit of Lake Andes.

North Unit

Water levels in this unit steadily declined all year. By the end of the year water levels had dropped 2.25 feet.

Breeding pairs on the unit in 1968 were 110 compared to 32 in 1967. Brood numbers were 20 in 1968 and 16 in 1967.

During the year 23,700 pounds of bullheads were removed from this unit by a commercial fisherman. A partial summer fish kill occurred in the unit.

Hardstem bulrush and some cattail were present. Sago pondweed was also abundant.

Center Unit

Water levels declined from January to September. Fall rains then raised the water levels. Even with this raise the net change in water levels for the year was a decline of 1.66 feet. The maximum water depth at the end of the year is probably 2 feet. This unit will probably freeze to the bottom during the winter of 1968-9. Water in this unit was the most turbid of all units.

Breeding pairs increased from 36 in 1967 to 128 in 1968. Brood use declined from 33 in 1967 to 17 in 1968.

There were no emergents in this unit but sago pondweed was abundant.

A heavy summer fish kill occurred. No fish were removed by the commercial fishermen in 1968.

South Unit

Water levels in the unit declined steadily throughout the year. The decrease totaled 2.05 feet. A check in December at what is considered the deepest part of the lake revealed 14 inches of ice and 16 inches of water.

There were 310 breeding pairs in 1968 compared to 105 in 1967 for an increase of 205 pairs. However, brood use declined from 12 in 1967 to 8 in 1968.

Commercial fishermen removed 40,100 pounds of bullheads during the year. Netting just before freeze up produced bullheads as well as a very few northern pike, black bass, and yellow perch. However, this unit will probably winter kill

There were no emergents in this unit. However, sago pondweed growth was good.

Owens Bay

Water levels in this unit fluctuate very little due to the constant flow of the artesian well. The maximum variation throughout the year was .8 feet. Any overflow from this unit enters the south unit.

Hardstem bulrush and some cattail are found in this unit. Sago pondweed growth was good. The water in this unit remained clear throughout the summer.

For the first time water from the artesian well was diverted into some lowland areas to the northwest of the well. This diversion was started on April 30 and terminated on July 22. Approximately 25% of the well flow was diverted into this wetland. Based on the well flow of 750 gallon per minute this would amount to about 690 acre feet. This flooded area proved to be an excellent waterfowl area and 35 breeding pairs were counted on the wetland.

B. Summary

Precipitation for the year totaled 20.39 inches or .83 inches below normal. Highlights were that July and August were drier than normal and September and October were wetter than normal. Heavy snow in December left 17 inches of snow cover on the ground as of December 31, 1968. Weather bureau records at Sioux Falls for December, 1968 showed more snow than anytime since the late 1890's.

Water levels in all units of Lake Andes continued to decline throughout the year. With the snow cover present at the end of the year there is the prospect for good runoff in the spring of 1969.

The weir box was completed at the artesian well. This allowed the refuge to create some new wetlands for the first time this year. It will also allow us to get more accurate well flow readings in 1969.

C. Recommendations for Water Management in 1969

Water levels in Lake Andes should be maintained at the optimum level of 1436.75 if possible. This is.5 feet below the maximum outlet elevation of 1437.25. Due to local flooding complaints in high water years this .5 feet buffer zone is desirable.

It is recommended that Owens Bay be maintained as close as possible to the maximum of 1440.00. This unit was not drawn down in 1968 and the quality and quantity of vegetation appears good.

The artesian well flow should be diverted into the wetland area northwest of the well starting about March 10. The flow should continue into this area until the lowland areas are flooded and then be diverted back into Owens Bay.

Well flow measurements will be taken monthly.

IMPOUNDMENT DATA - 1968

	North Unit			Center Unit		
	Average Elevation	Area (Acres)	Capacity (acre feet)	Average Elevation	Area (Acres)	Capacity (acre feet)
January	1434.27	468	1060	1430.52	1725	3800
February	1434.27	468	1060	1430.52	1725	3800
March	1434.27	468	1060	1430.52	1725	3800
April	1433.16	364	580	1430.10	1638	3200
May	1433.05	352	540	1430.01	1625	3100
June	1433.01	348	525	1429.87	1600	2950
July	1433.00	348	525	1428.21	750	1000
August	1433.00	348	525	1428.00	500	900
September	1432.11	240	260	1428.87	1300	1600
October	1432.02	228	245	1428.86	1300	1600
November	1432.02	228	245	1428.86	1300	1600
December	1432.02	228	245	1428.86	1300	1600

	South Unit			Owens Bay Unit		
January	1431.61	1590	5400	1440.00	203	300
February	1431.61	1590	5400	1440.00	203	300
March	1431.61	1590	5400	1440.00	203	300
April	1431.29	1570	5000	1440.00	203	300
May	1431.29	1570	5000	1439.64	188	240
June	1431.16	1560	4800	1439.58	181	220
July	1430.56	1550	3850	1439.37	160	190
August	1429.89	1450	3000	1439.20	143	165
September	1429.61	1370	2700	1439.39	165	200
October	1429.56	1370	2700	1439.60	185	230
November	1429.56	1370	2700	1439.66	188	240
December	1429.56	1370	2700	1439.66	188	240

1/ see new table in Engr. Ronnie's memo.

SUMMARY OF INFLOW AND OUTFLOW 1968

	A Ave. Annual Evap.	B 1968 Lake Rise	C Net Gain A+B	D Surface Acres	E Ac-Ft Gain CxD	F Outflow in ac-ft	G Total Inflow ac-ft E+F
North Unit	3.15	-2.25	.90	~~318~~ 327	~~286.2~~ 294	none	~~286.2~~ 294
Center Unit	3.15	-1.66	1.49	~~1,245~~ 1,328	~~2,066.7~~ 1,979	none	~~2,066.7~~ 1,979
South Unit	3.15	-2.05	1.10	~~1,491~~ 1527	~~1,640.1~~ 1680	none	~~1,640.1~~ 1680
Owens Bay	3.15	-.34	2.81	~~175~~ 158	~~491.8~~ 444	80.0	~~571.8~~ 524
Wetland Unit NW of well	25% of the well flow flowed into this area for 84 days. With the well flow at 750 gallons per minute this would amount to 690 acre feet.			3340			4477